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14. ABSTRACT
The attached report summarizes the long term goals, project objectives, approach, complete work/results, and implications of the 2004 SeaGlider Exercise.

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Mine Counter Measure Exercise With Seaglider

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LONG-TERM GOALS

To operate a Seaglider UUV during technology demonstrations for the Navy and analyze resultant measured data, vehicle performance, and user interface issues to evaluate the Navy acquisition program potential of glider UUV technology.

OBJECTIVES

The preparation and employment of one Seaglider, an ocean glider UUV, for use in a Navy MCM-related exercise. The glider will be readied, shipped, operated, recovered, and returned to APL-UW. The glider interface system will automatically generate Navy-formatted message files containing environmental data collected by the glider on each dive. The interface system will automatically send these files for re-distribution, using Navy channels, to user installations of interest during the exercise. The data will be assimilated by various fleet commands to support both MCM and ASW missions. Measured and vehicle-related data, user interface issues, and MCM and ASW mission impact will be recorded and analyzed.

APPROACH

Use existing glider operation and maintenance procedures to prepare and employ a glider in a Navy exercise. Modify existing glider interface software to 1) automatically reformat measured environmental data from the glider into Navy standard message format files, and 2) transmit those files into Navy channels for normal distribution. Files may have to be passed to NMCI machines for re-transmission by sneaker-net, floppy, or some other method as they are received from the glider interface system. The new software capability will be tested well in advance of the Navy exercise to confirm functionality.

WORK COMPLETED

The Navy exercise that was to involve the use of Seaglider was moved from the fall, 2003 to early summer, 2004 (CJTFX). In February 2004, it was determined that the shallow waters of Onslow Bay in which CJTFX was to be conducted would not provide a suitable demonstration of the capabilities of Seaglider. RIMPAC04 was selected as an alternative with ASW as the main mission for which to

provide support. The cognizant ONR Program Manager accepted this arrangement and the carry-over of funding from FY03 to FY04. Software development through spring 2004, capitalizing on the successful operation of Seaglider Hull 005 off the Washington coast and, later, Hull 002, provided Seaglider Hull 019 with the latest flight control and user-interface software to date. Operational concepts for the exercise were developed and a 48-hour simulation was performed 29-30 March. During the simulation, representative JJVV, MEDAL, and UWCOND messages were transmitted at three-hour intervals to the then-three centers that would plan to use actual data once RIMPAC04 battle space preparations were underway in mid-June: NPMOC-Pearl Harbor, NPMOC-San Diego, and WSC-NAVOCEANO. Out of an analysis of the acoustic ramifications of the simulated data arose the theory that semi-diurnal variability in water column conditions might both be measurable by Seaglider and produce enough difference in sensor performance predictions to be tactically significant. Operational concepts were further refined to evaluate this theory.

Seaglider 019 was successfully launched at 21-00N, 158-10W on 15 June, 2004 by Torpedo Retriever (TWR) 7, Chaparral from Pearl Harbor (figure (1)). The glider flew for 27 days. It received command, track, and science input files and transmitted data messages ashore for 25 of those days (until 0230W 7/9). It appeared to receive but not respond to command files and returned GPS fixes only for the remaining two days. Communication was lost after 1612 7/11. No clear indications of the cause for the sudden loss of message transfer and command file response capability are apparent. An unsuccessful recovery effort was initiated from Kona on 7/15 after which the glider was presumed lost at sea. Navy commands have posted a notice in local papers that the glider may drift ashore encouraging anyone who finds it to aid in recovery.

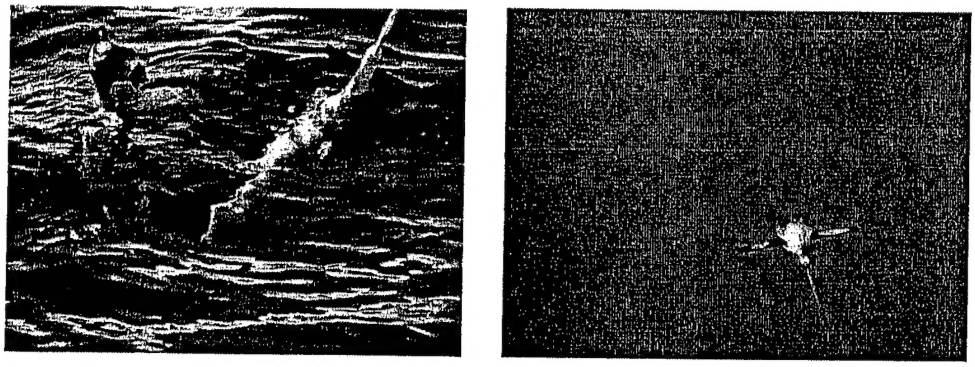

Figure (1a). APL-UW technician Keith Van Thiel assisting with the launch of Seaglider from USS Chaparral (simmers are not required to launch the glider). Figure (1b). Seaglider photograph taken underwater during its first RIMPAC mission profile.

RESULTS

Seaglider's employment in RIMPAC met most of the objectives established by the Fleet METOC officer, Captain Ernest Petzrick, in spring 2004. They are enumerated as follows.

1. Show glider profiling can improve fleet ASW capability
   - Demonstrate pipeline of glider data into MODAS/Lite - **successful**
   - Demonstrate value of capturing diurnal variability via MODAS fields sent to fleet for optimizing sensor / platform placement and sensor settings – **successful**; diurnal variability in terms of thermocline observations was detected by Seaglider (12-14 hour period waves) but these proved to have a significant effect on propagation estimations

for ranges marking the transition between direct path and bottom bounce propagation and, where it existed, between bottom bounce and convergence zone propagation.
  - Extrapolate value of having more than a single profiling glider in battle space preparation (in work) – this has proven more difficult than expected due to the lack of fleet in situ data collected during RIMPAC. **More data will be needed** in the future to answer this question, whether it's collected by a glider or other organic sensors.
2. Demonstrate ocean acoustic variability to fleet and its contribution to sensor performance uncertainty – **successful**; NPMOC Pearl Harbor presented to the summer ASWIP conference in Norfolk results of acoustic modeling that showed the variability between modeled results with and without glider data and the minor profile-to-profile variability in propagation described above due to diurnal fluctuations.
3. Show glider profiling can improve fleet MIW/SPECWAR capability (**not demonstrated**; Seaglider did not engage in any MIW/SPECWAR-related scenarios)
4. Show glider command and control supports COMSUBPAC WSM (**successful**; it will be useful for the Submarine community to pursue a permanent waiver for treating gliders as "hard interference" so they might be used to measure water column properties truly "in situ." COMSUBPAC is pursing this.), MIW/SPECWAR communities (**not demonstrated**)
5. Demonstrate comparison between glider data and NCOM – **successful**; glider data, particularly near the surface, showed important differences compared with both NCOM model results and MODAS. Deeper, NCOM and MODAS both compared favorably with glider data.
6. Demonstrate glider recovery via Tactical Platform - **not demonstrated**; Lithium battery safety concerns resulted in NAVSEASYSCOM disapproval of a limited use certification for carrying gliders on Navy ships pending the establishment of operating and casualty procedures and/or mechanical and electrical safety design changes to the glider. Procedures are being reviewed by the Commander, Naval Ordnance Safety and Security Activity (NOSSA) as of fall, 2004.

In addition to these objectives, those listed in the Objective section have similarly been met.

IMPACT/APPLICATIONS

Seaglider, representing the potential that all glider ocean profilers in existence today have, stands to provide the Navy with several remote sensing applications. RIMPAC demonstrated the value of timely, accurate ocean temperature and salinity profile data and the ease with which that data can be assimilated and applied in Navy models. This experience will serve as a basis for future proposals to advance this technology in a host of important ways to improve its tactical utility to the Navy. CNMOC, NAVOCEANO, SPAWAR, and ONR have expressed strong interest in developing a prototype system consisting of a family of glider AUVs in order to develop their individual and collective capabilities, including operational concepts by which they will be employed. CNMOC recently committed $3.0M over FY05 and FY06 to the ONR Glider Technology Transition Initiative Proposal to fully support the development and testing of operational CONOPS for glider employment.

RELATED PROJECTS

Work associated with a separately ONR funded grant awarded to Russ Light of APL-UW to fabricate one Seaglider was completed in 2004. Remaining funds from the fabrication budget were used to cover final operating costs associated with this project. ONR has recently funded both an FY04 DURIP to build two additional gliders and to employ a Seaglider in the forthcoming fall 2004 TASWEX-04 exercise.